Formulary

Except as otherwise noted (in footnotes), references for this information are:

Blesdoe, B. E. & Clayden, D. E. (2019). *Prehospital emergency pharmacology* (8th ed.). New York, NY: Pearson.

[redacted]

Both of these references are available at the [redacted] for your reference.

Doses that fall outside of the range as recommended in the above texts are noted with alternative references; doses that specify a more specific range within the range listed (per the text above) are not specifically noted and these determinations have been made at the discretion of both [redacted] Medical Director and Clinical Base Manager.

In some cases, there is additional information beyond that listed in these references; those data points and insights have also been noted with footnotes and are separated from the information provided by the primary reference by a semicolon.

Notes:

- Hypersensitivity or history of an anaphylactic reaction to a drug or any of its component is always an absolute contraindication and is not repeated here for each medication listed.
- Indications and contraindications listed refer to use in the HEMS setting – there may be additional information listed on other drug references that do not necessarily apply to our work environment
- Contraindications are notated as either:
    - "Absolute" to indicate that the medication should never be used unless all clinicians in Med Crew agree to justify an exclusion
    - "Precautions" to indicate relative contraindications or cases in which clinicians should consider the consequences for specific reasons and determine if risk outweighs the benefit
- Other uses listed refer to things that fall outside of the FRGs, but that we may encounter in a transport setting
- For all concentrations with mixed preparations, it is assumed that the volume of medication will be removed prior to adding the medication and its solute (i.e. 200mg Labetalol in 100ml fluid to yield 2mg/ml will not work if 200mg in 40ml is added to 100ml fluid – that 40ml must be wasted from the 100ml bag first)

Medications Carried by [redacted]
(and with profiles in this document)

Acetaminophen / Paracetamol.... ...3
Adenosine... ...4
Albuterol / Salbutamol (& Levalbuterol)... ...5
Amiodarone... ...7
Aspirin... ...9
Atropine... ...10
Calcium Salts... ...12
Ceftriaxone... ...14
Crystalloids.... ...15
Dextrose... ...16
(Dextrose 5% in Water – see Crystalloids)
Diltiazem... ...17
Diphenhydramine... ...18
Dopamine... ...19
Epinephrine... ...20
Etomidate... ...22
Fentanyl... ...23
Furosemide... ...24
Heparin... ...25
Hydralazine... ...26
Ipratropium... ...27
(Insulin – see Regular Insulin)
Ketamine... ...28
Labetalol... ...29
(Lactated Ringers – see Crystalloids)
Lidocaine... ...30
Magnesium Sulfate... ...32
Mannitol... ...34
Methylprednisolone... ...35
Metoprolol... ...37
Midazolam... ...38
Morphine... ...39
Naloxone... ...40
Nitroglycerin... ...41
Norepinephrine... ...42
(Normal Saline – see Crystalloids)
Ondansetron... ...43
Oxytocin... ...44
Phenytoin... ...45
Promethazine... ...46
Propofol... ...47
(Racemic Epinephrine – see Epinephrine)
Regular Insulin... ...48
Rocuronium... ...49
Sodium Bicarbonate... ...50
Streptokinase... ...51
Succinylcholine... ...53
Terbutaline... ...54
Tetanus Immune Globulin (TIG)/ Tetanus Anti-Toxin... ...55
Tranexamic Acid (TXA)... ...57
Vasopressin... ...58
Vecuronium... ...59

Medications Listed in FRGs, but not carried by [redacted] (and not with profiles in this document)

Diazepam
Glucagon
N-acetylcysteine
Octreotide
Omeprazole
Potassium Chloride

Digibind (typically not available [redacted]
Flumazenil (typically not available [redacted]
Pralidoxime (typically not available [redacted]
Cyanokit (typically not available [redacted]

Acetaminophen/Paracetamol	
Class	Non-narcotic analgesic, antipyretic
Mechanism of Action[1]	Acetaminophen produces its antipyretic effect by inhibiting prostaglandin synthesis in the CNS and blocking the actions of endogenous pyrogens at the hypothalamic thermoregulatory centers. Its antipyretic and analgesic properties are similar to those of NSAIDs, but it does not have significant anti-inflammatory and platelet effects.
Indications	Infection and Fever: to reduce fever Other uses: mild to moderate pain
Absolute Contraindications	Severe hepatic impairment[2]
Precautions[3]	Use caution with concurrent liver disease (hepatic metabolism)[4] Toxicity may occur with excessive doses (typically only with over 4g per day adults, over 75mg/kg/day pediatrics) **Pregnancy Category B**[5]
Adverse Effects	Minimal within recommended dosage range
Onset	15-30 minutes *(peak 30-120 minutes)*
Duration	3-4 hours *(half-life 1-3 hours)*
Dose	*Adult & Pediatric*: 10-15mg/kg PR (max1000mg), once

[1] PDR Network (2018)
[2] PDR Network (2018)
[3] Children listed <3 was listed as a contraindication, I removed that for two reasons: we tend to use Tylenol more for little one, the reason listed in the PDR was due to risk of OD (which we can mitigate)
[4] PDR Network (2018)
[5] Black & Hill (2003)

Adenosine	
Class	Antiarrhythmic (Class V)
Mechanism of Action	Adenosine slows conduction through the AV node, can interrupt the reentry pathways through the AV node, and can restore normal sinus rhythm in patients with PSVT, including PSVT associated with WPW syndrome.
Indications	Dysrhythmia: regular monomorphic symptomatic tachycardia
Absolute Contraindications	• Second- or third-degree AV block or sick sinus syndrome (except in patients with a functioning pacemaker) • Irregular (atrial fibrillation) or polymorphic (Torsades) tachycardia • Poison- or drug-induced tahcycardia[6]
Precautions	Use caution with concurrent: • Asthma (can cause bronchospasm) • Hepatic and renal failure[7] • Methylxanthine[8] use (can decrease efficacy, thus requiring a larger dose) • Use of medications that block nucleotide transport (can potentiate effects– consider using half the initial dose) [9] May cause transient dysrhythmia (asystole or bradycardia) and/ or ectopic beats [10] **Pregnancy Category C**
Adverse Effects	***Neurologic:*** lightheadedness, dizziness, tingling or heaviness in the arms, numbness, apprehension, blurred vision, burning sensation, neck and back pain, head pressure/ headache ***Respiratory:*** shortness of breath, dyspnea, hyperventilation ***Cardiovascular:*** chest pressure/ pain, palpitations, hypotension ***GI/GU:*** nausea ***Skin:*** flushing, diaphoresis
Onset	20-30 seconds *(peak20-30 seconds)*
Duration	30 seconds *(half-life 10 seconds)*
Dose	*Adult:* 6mg rapid IV push; repeat once at 12mg as needed *Pediatric:* 0.1mg/kg rapid IV push; repeat once at 0.2mg/kg as needed *Consider giving larger dose (6mg or 0.2mg/kg) for both initial and subsequent dose[11]

[6] ACLS (2015), p170
[7] Was unable to verify this – need to review metabolism, but I think it would be ok in these cases
[8] Examples include caffeine and theophylline
[9] Examples include Dipyridamole (Persantine) or carbamazepine
[10] ACLS (2015) p170
[11] These doses are per ACLS (2015) & PALS (2015), however additional guidance per [redacted] Medical Director

Albuterol/Salbutamol (& Levalbuterol)	
Class	Sympathomimetic *(β_2 selective)*, bronchodilator
Mechanism of Action	Albuterol is a bronchodilator that exerts effects primarily on the beta-2 adrenergic receptors on bronchial smooth muscle, causing relaxation and facilitating optimal airflow. It affects all airways, from the trachea to the terminal bronchioles. Albuterol can cause cardiovascular effects, as there is a small population of beta-2 receptors in the cardiac muscle. Levalbuterol is the R-stereoisomer of albuterol that is more selective to receptors (has greater binding affinity) than the S-stereoisomer, therefore smaller doses are needed, resulting in less cardiovascular side effects than albuterol.[12]
Indications	Bronchospasm: to cause bronchodilation with reversable etiology (i.e. asthma, COPD, allergic reaction) Hyperkalemia & Crush Injury: to shift potassium back in to the intracellular space
Absolute Contraindications	None in the emergency setting
Precautions	Consider cardiovascular effects (especially in patients with cardiac disease or cardiovascular disorders) and monitor closely May cause or exacerbate hypokalemia Consider drug interactions: • MAOIs/ TCAs: may potentiate cardiovascular side effects • Diuretics: may exacerbate hypokalemia (and thus cause EKG changes) • Digoxin: may cause an increase in serum digoxin levels **Pregnancy Category C**
Adverse Effects	***Neurologic:*** anxiety, headache, dizziness, tremors ***Cardiovascular:*** palpitations, tachycardia, chest pain ***Skin:*** sweating ***Endocrine/ Metabolic:*** hypokalemia
Onset	5-15 minutes *(peak 60-90 minutes)*
Duration	3-6 hours *(half-life 3 hours)*

[12] PDR Network (2018)

Dose	***Bronchospasm*** *Albuterol* *Adult*: 2.5mg NEB, repeat as needed *Pediatric*: 2.5mg NEB, repeat as needed to max 10mg/hr *Levalbuterol*[13] *Adult & Pediatric:* 1.25mg NEB, repeat as needed ***Hyperkalemia*** (Electrolyte Abnormalities, Crush Injury) *Albuterol* *Adult*: 5mg NEB, once *Pediatric*: 2.5mg NEB, once *Levalbuterol*[14] *Adult:* 2.5mg NEB, once *Pediatric:* 1.25mg NEB, once

[13] PDR Network (2018)
[14] PDR Network (2018)

Amiodarone	
Class	Antidysrhythmic (primarily Class III)
Mechanism of Action	Amiodarone is generally considered a class III antiarrhythmic drug, but it possesses electrophysiological characteristics of all four classes. Like class I it blocks Na channels at rapid pacing frequencies, and like class II drugs it exerts a noncompetitive antisympathetic action. One of its main affects is to lengthen the cardiac action potential, a class III action. It also has negative chronotropic effect much like class IV drugs. It also blocks both K and Ca channels which contribute to the slowing of conduction. Its vasodilatory action can decrease cardiac workload decreasing myocardial oxygen consumption.
Indications	Dysrhythmia: stable wide-QRS tachycardia (includes perfusing ventricular tachycardia), stable narrow-QRS tachycardia Cardiac Arrest: pulseless ventricular tachycardia, ventricular fibrillation
Absolute Contraindications[15]	None in the emergent setting
Precautions	Use caution with concurrent: • Cardiogenic shock[16] (can contribute to heart failure) • Hypokalemia and hypomagnesemia (to reduce risk of Torsades resulting from long QT and amiodarone administration) - should be corrected prior to administration May worsen existing dysrhythmias Rapid administration may worsen hypotension **Pregnancy Category D**
Adverse Effects	***Neurologic:*** malaise, fatigue, tremors ***Respiratory:*** pulmonary toxicity ***Cardiovascular:*** hypotension, ventricular ectopic beats, bradycardia ***GI/GU:*** nausea, anorexia
Onset	1-3 minutes *(peak 8-12 hours)*
Duration	Varies *(half-life 40-55 days)*

[15] Marked sinus bradycardia, second- or third-degree heart blocks (unless functioning pacer available), severe sinus node disfunction – these were all listed, but don't apply if we give the med as indicated above

[16] This was listed as a contraindication, but I moved it to precaution/ relative contraindication because cardiogenic shock may be caused by a dysrhythmia we want to treat with this med

Dose[17]	***Stable Wide-QRS Tachycardia*** (includes Perfusing Ventricular Tachycardia) *Adult:* 150mg IV over 10min, repeat as needed; follow by infusion at 1mg/min for the first 6 hours after conversion *Pediatric:* 5mg/kg IV over 20-60min ***Stable Narrow-QRS Tachycardia*** *Adult:* 150mg IV over 10min, once *Pediatric:* not indicated ***Cardiac Arrest*** (VF/pVT) *Adult:* 300mg IV/IO, may repeat at 150mg once *Pediatric:* 5mg/kg IV/IO, repeat as needed to 3 total doses

[17] ACLS (2015; PALS (2015)

Aspirin	
Class	Platelet inhibitor, anti-inflammatory, analgesic, salicylate
Mechanism of Action	Though its effects are varied, aspirin's primary function in the emergency care setting is to reduce blood coagulability (by inhibiting platelet aggregation) as a means of preventing acute coronary syndrome (ACS) and improving outcomes in that event.
Indications	Acute Coronary Syndrome: to inhibit platelet aggregation and prevent progression/ worsening of ischemia
Absolute Contraindications	None is the emergent setting
Precautions[18]	Use caution with concurrent: • Recent stroke (CVA), GI bleed, ulcers, hypoprothrombinemia, vitamin K deficiency, severe liver damage, surgical patients (can cause or worsen bleeding) • Allergies to other NSAIDs, asthma, nasal polyps or allergies (due to increased risk of allergic reaction/ anaphylaxis[19]) **Pregnancy Category D**
Adverse Effects[20]	***Neurologic:*** tinnitus (with overdose), vertigo, reversible hearing loss, visual changes ***Respiratory:*** wheezing ***Cardiovascular:*** prolonged bleeding time ***GI/GU:*** heartburn, nausea, vomiting, dyspepsia, thirst, GI bleeding, ulceration ***Skin:*** urticaria, angioedema
Onset	5-10 minutes *(peak 15-120 minutes)*
Duration	1-4 hours *(half-life 15-20 minutes)*
Dose	*Adult:* 162-325mg PO once *Pediatric:* not indicated

[18] Not recommended for use with young children or teenagers (due to risk of Reye's Syndrome) – removed this since we only use with adults

[19] PDR Network (2018)

[20] A lot of these refer to chronic use at high doses, not specific to use in the HEMS setting: how about "minimal within recommended dose range" like we did for acetaminophen?

Atropine	
Class	Parasympatholytic, anticholinergic, vagolytic
Mechanism of Action	Blocks acetylcholine's effects on the SA and AV nodes, increasing conduction velocity. Also increases sinus node discharge rate and decreases the AV node's refractory period. Result is an increased heart rate. Decreases the action of the parasympathetic nervous system on bronchial, salivary and sweat glands, resulting in decreased secretions. Decreases cholinergic effects on the iris, ciliary body and bronchial smooth muscle.
Indications	Bradycardia: to increase the heart rate Organophosphate Exposure: to reverse symptoms of cholinergic overdose/ exposure
Absolute Contraindications	• Hypersensitivity to belladonna alkaloids • Bradycardia due to hypothermia[21]
Precautions	Use caution with concurrent:[22] • Acute cardiac ischemia (can increase myocardial oxygen demand) • Glaucoma (can increase IOP and cause dryness) • Obstructive uropathy (can worsen urinary retention, metabolism may be impaired) • GI disease to include paralytic ileus or toxic megacolon (can decreases GI motility to worsen symptoms) • Myasthenia gravis (can exacerbate symptoms) Dose of 3 mg should not be exceeded *except* in cases of organophosphate poisonings Will not be effective with bradycardias in patient with history of heart transplant May not be effective with second- and third-degree heart block Small doses may lead to a paradoxical slowing of the HR (minimum dose 0.1mg) Intense flushing of the face (blush area) and trunk may occur following administration, this is called "atropine flush" and is not harmful[23] **Pregnancy Category C**
Adverse Effects	***Neurologic:*** headache, dizziness, anxiety, pupillary dilation, blurred vision, delirium, ataxia, tremors ***Cardiovascular:*** palpitations, tachycardia, bradycardia, ***GI/GU:*** dry mouth, urinary retention, GI distress, constipation ***Skin:*** hot and dry skin

[21] ACLS (2015), p 171
[22] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)
[23] PDR Network (2018)

Onset	Immediate *(peak 2-4 minutes)*
Duration	4 hours *(half-life 2-3 hours)*
Dose	***Bradycardia*** *Adult:* 0.5mg IV, repeat every 3-5min to a max of 3 mg *Pediatric:* 0.02 mg/kg (min 0.1 mg; max single dose 0.5 mg) ***Organophosphate Exposure***: *Adult*: 2mg IV, repeat as needed *Pediatric*: 0.05mg/kg (max 2mg), repeat as needed[24]

[24] PDR Network (2018)

Calcium Salts	
Class	Electrolyte and mineral
Mechanism of Action[25]	Calcium is essential for the nervous, skeletal and muscular systems. It is essential for maintaining cell membrane and capillary permeability – serving as an activator of nerve impulses, cardiac function, and blood coagulation. Stabilizes myocardial membranes associated with hyperkalemia.
Indications	Electrolyte Abnormality: to reverse hypocalcemia, to stabilize cardiac cells with hyperkalemia Endocrine Disorders: to reverse hypocalcemia related to hypoparathyroidism Toxic Exposure: to mitigate the effects of a calcium channel blocker[26] or magnesium sulfate overdose, to prevent dysrhythmias with hydrofluoric acid exposure Crush Injury: to stabilize cardiac cells with hyperkalemia Other uses: black widow spider bites
Absolute Contraindications	• Hypercalcemia • Ventricular fibrillation
Precautions	Use caution with concurrent: • Digitalis use or toxicity (calcium could theoretically increase effects[27]) • Known or suspected hyperphosphatemia[28] • Lactation (because no data exists on safety)[29] • Calcium supplementation (possibility for hypercalcemia) IV line should be flushed thoroughly between calcium chloride and sodium bicarbonate administration if not able to obtain a second IV line (preferred) Should be given slowly (to avoid hemodynamic instability and prevent local irritation) **Pregnancy Category C**
Adverse Effects	***Neurologic:*** sensory disturbances (chalky taste in the mouth, tingling, "hot flashes") ***Cardiovascular:*** dysrhythmias (bradycardia and asystole) ***Skin:*** local necrosis with extravasation
Onset	Immediate *(peak unknown)*
Duration	30-90 min[30] *(half-life not applicable)*

[25] Barringer Group, LLC (2019)
[26] Such as Nifedipine or Verpamil
[27] Nickson (2019)
[28] Need a good reason – maybe r/t calcification/ deposits in tissue?
[29] PDR Network (2018)
[30] Barringer Group, LLC (2019)

Dose[31]	Calcium Chloride *Adult*: 1g IV over 2-5min (10ml or 1 Amp) *Pediatric*: 20mg/kg (max 1g) over 2-5min, once Calcium Gluconate *Adult*: 1-2g over 2-5min, once [10-20ml or 1-2vials] *Pediatric*: 20mg/kg (max 2g) over 25min, once
Notes	There is a three-fold difference in the amount of elemental calcium each medication contains: • Calcium Gluconate 10% contains 0.45mEq/ml or 9.3mg • Calcium Chloride 10% contains 1.36mEq/ml or 27.2mg Calcium Chloride ionizes more readily and is more potent, but also more irritating to the tissues.

[31] Normal adult dose for Calcium Salts is 500-1000mg, however doses have been adjusted due to reflect difference between two preparations

Ceftriaxone[32]	
Class	Broad-spectrum cephalosporin antibiotic
Mechanism of Action	Ceftriaxone is a bactericidal agent that acts by inhibition of bacterial cell wall synthesis. Ceftriaxone has activity in the presence of some beta-lactamases, both penicillinases and cephalosporinases, of Gram-negative and Gram-positive bacteria.
Indications	Infections & Fever & Meningitis: to initiate antibiotic therapy Trauma: to prevent infection with open wounds
Absolute Contraindications	• Hypersensitivity to penicillins or cephalosporins • Premature and hyperbilirubinemic neonates (can displace bilirubin from albumin[33]) • Neonates receiving calcium salts (risk for precipitation of calcium-ceftriaxone salts[34])
Precautions	May precipitate with calcium-containing products (i.e. Lactated Ringers) Use caution with pancreatitis or hepatic impairment (excretion is both biliary and hepatic) May cause bleeding when given concurrently with Vitamin K
Adverse Effects	***Cardiovascular:*** hematologic effects (primarily eosinophilia and thrombocytosis), elevated liver enzymes ***Skin:*** pain or irritation at injection side ***GI/GI:*** diarrhea/ loose stools
Onset	Within hours
Duration	Not applicable *(half-life 4.3-6.6 hours in healthy subjects)*
Dose[35]	***Infection and Fever, Trauma*** *Adult:* 1-2g IV/IM over 2-5min, once *Pediatric:* 50mg/kg (max 2g) IV/IM over 2-5min, once ***Meningitis*** *Adult*: 2g IV/IM over 2-5min, once *Pediatric*: 100mg/kg (max 2g) IV/IM over 2-5min, once

[32] Sandoz GmbH (2015)
[33] PDR Network (2018)
[34] PDR Network (2018)
[35] Doses confirmed in PDR Network (2018)

Crystalloids	
Class	• Normal Saline (NS) – isotonic solution composed of sodium chloride in water • Lactated Ringers (LR) – isotonic solutions composed of sodium chloride, potassium chloride and sodium lactate in water • 5% Dextrose in Water (D5W) – hypotonic glucose solution with water
Mechanism of Action	NS and LR are used to replace fluid by immediate expansion of circulatory volume. Due to the movement of electrolytes and water, however, two-thirds of this volume is lost within one hour. LR also contains lactate (lactic acid) which acts as a buffer. D5W is readily pulled in to the intracellular space as glucose is metabolized, resulting in a more hypotonic solution[36]
Indications	• NS/LR are used for volume replacement; unless indicated otherwise in the FRGs, these can be used interchangeably • D5W is primarily used for the dilution of other medications; can also be used to provide small amounts of dextrose and to provide free water when Na and Cl are elevated[37]
Absolute Contraindications	None
Precautions	• General: use caution with CHF/ pulmonary edema (administration of IV fluids can worsen symptoms) • NS: dilutes RBCs and plasma proteins, can cause hyperchloremic metabolic acidosis[38] • LR: use caution with renal failure[39] • D5W: can dilute electrolytes and plasma proteins resulting in hyponatremia and cellular edema[40] (therefore use caution with stroke or head injury)
Adverse Effects	NS/LR: not applicable (other than as related to precautions above) D5W: can cause skin/ tissue irritation with administration and necrosis with extravasation
Onset	Immediate
Duration	Varies
Dose	"IV Fluids" refers to NS/LR at 20ml/kg over 15 minutes "Maintenance fluids" refers to: *Adult:* 125ml/hr NS/LR *Pediatric:* PALS 4:2:1 Rule 4ml/kg/hr for the first 10kg 2ml/kg for the second 10kg 1ml/kg/hr for every kg over 20kg

[36] And as a side note: some sources describe D5W as an isotonic solution, but it quickly becomes a hypotonic solution upon administration; UNMH (2019)
[37] Barringer Group, LLC (2019)
[38] Barringer Group, LLC (2019)
[39] Need to verify this, see to what extent (and if it is relevant in our setting)
[40] Barringer Group, LLC (2019)

Dextrose	
Class	Carbohydrate
Mechanism of Action	Provides calories necessary for amino acid anabolism and helps maintain blood glucose levels in the absence of sufficient oral intake. Dextrose is readily metabolized, and it increases blood glucose concentrations.
Indications	Altered Mental Status & Management of the Sick Baby: to reverse hypoglycemia Electrolyte Abnormality & Crush Injury: to facilitate a shift of potassium back in to the intracellular space (in conjunction with insulin administration)
Absolute Contraindications	None in emergency setting
Precautions	BGL should be obtained before and after the administration of glucose May cause or worsen cerebral edema and cause an increase in ICP with rapid administration Dextrose should not be given via SQ or IM routes - can cause tissue necrosis, phlebitis, sclerosis or thrombosis at injection site Can cause sever neurologic symptoms (Wernicke's Encephalopathy, Korsakoff's Psychosis) with thiamine deficiency **Pregnancy Category C**
Adverse Effects	***Neurologic:*** fever ***Skin:*** local venous irritation (warmth, pain, burning)
Onset	< 1 minute *(peak variable)*
Duration	Varies *(half-life not applicable)*
Dose	*Adult*: 25g IV [50ml D50] *Pediatric ≥2 years*: 0.5g/kg IV [1ml/kg D50 or 2ml/kg D25] *Pediatric <2 years*: 0.5-1g/kg IV [2-4ml/kg D25, do not use D50] *Neonate*: 0.5-1g/kg [5-10ml/kg D10 or 10-20ml/kg D5]
How to Mix	To make Dextrose 25%: • Waste 25ml from Amp of D50, add 25ml of fluid • Waste 50ml from 100ml of fluid, add Amp of D50 To make Dextrose 10%: • Waste 40ml from Amp of D50, add 40ml of fluid • Waste 50ml from 250ml of fluid, add Amp of D50 Amp of D50 = 50m Dextrose 50%

Diltiazem	
Class	Calcium channel blocker
Mechanism of Action	Inhibits calcium ion influx into vascular smooth muscle and myocardium, relaxing smooth muscle, decreasing peripheral vascular resistance, dilating coronary arteries and prolonging AV node refractory period.
Indications	Dysrhythmia: to convert or control the rate of refractory stable narrow-QRS tachycardia
Absolute Contraindications[41]	Physiologic reason for tachycardia (such as heart failure, hypovolemia, pain – treat those causes instead)
Precautions	Use caution with concurrent: • β-blocker use (can increase risk of CHF, bradycardia and asystole) • Digoxin or quinidine sue (can cause toxicity) • Cimetidine use (can potentiate effects of diltiazem) • Cyclosporine use (can increase serum levels) • Cardiac conduction disturbances[42] • Hypotension (can exacerbate hypotension by decreasing cardiac output) **Pregnancy Category C**
Adverse Effects	***Neurologic:*** dizziness, headache ***Cardiovascular:*** hypotension, bradycardia, AV blocks, dysrhythmias, CHF ***GI/GU:*** nausea, vomiting
Onset	3 minutes *(peak 7 minutes)*
Duration	1-3 hours *(half-life 2 hours)*
Dose	*Adult:* 10mg IV over 2-5min, repeat once at 20mg IV over 2-5min as needed *Pediatric:* not indicated *Infusion:* 5-15mg/hr with conversion

[41] Bradycardia, AV blocks, acute MI with CHF, accessory bypass track (WPW Syndrome), ventricular tachycardia – these were all listed as contraindications, but don't apply if we use it only as indicated

[42] Will it cause something or just not work? – need to look in to this

Diphenhydramine	
Class	Antihistamine, H-1 receptor agonist
Mechanism of Action[43]	Diphenhydramine decreases the allergic response by competitively antagonizing the effects of histamine on H1-receptors in the GI tract, uterus, large blood vessels, and bronchial muscle producing anticholinergic, antipruritic, antiemetic, anti-dyskinetic, sedative effects. Diphenhydramine does not prevent the release of histamine or bind or inactive histamine.
Indications	Allergic Reaction: to mitigate effects of histamine release Other uses: to alleviate symptoms with dystonic reactions (such as those due to phenothiazines), to alleviate nausea with narcotic use (often attributed to histamine release)
Absolute Contraindications	None in the emergent setting
Precautions	Use caution with concurrent: • Acute asthma attack (can cause thickened secretions) • Lactation/ nursing (can interfere with lactation)[44] • Early development (newborn or premature infants – can cause sedation and increase risk of SIDS)[45] Can cause anticholinergic toxicity **Pregnancy Category B**
Adverse Effects	***Neurologic:*** convulsions, sedation, dizziness, blurred vision, paradoxical CNS stimulation, confusion ***Respiratory:*** wheezing, chest tightness, thickened secretions ***Cardiovascular:*** hypotension, tachycardia, palpitations ***GI/GU:*** dry mucous membranes, urinary retention ***Musculoskeletal:*** tremors ***Skin:*** rash
Onset	10-15 minutes *(peak 1 hour)*
Duration	6-8 hours *(half-life 1-4 hours)*
Dose	*Adult & Pediatric:* 1mg/kg (max 50mg) IV/ deep IM, once

[43] Barringer Group, LLC (2019)
[44] PDR Network (2018)
[45] PDR Network (2018)

Dopamine	
Class	Sympathomimetic, inotropic agent, vasopressor
Mechanism of Action[46]	Dopamine is a naturally occurring catecholamine that increases blood pressure, cardiac output, mesenteric, and cerebral vasodilation by stimulating dopaminergic receptors. Exerts inotropic effects on beta-1 and alpha-1 adrenergic receptors, which increases heart rate, blood flow, myocardial contractility, and stroke volume.
Indications	Shock & Hypotension: to increase cardiac output Dysrhythmia: to increase heart rate with symptomatic bradycardia refractory to atropine
Absolute Contraindications	• Hypovolemic shock in which complete fluid resuscitation has not occurred • Pheochromocytoma • Uncorrected tachyarrhythmias or ventricular arrythmias
Precautions	Beneficial effects lost when dose exceeds 20mcg/kg/min Can cause tissue damage with infiltration Doses greater than 10mcg/kg/min may cause renal vasoconstriction.[47] **Pregnancy Category C**
Adverse Effects	***Neurologic:*** headache ***Cardiovascular:*** ventricular tachydysrhythmias (especially with higher doses), hypertension, palpitations, angina, vasoconstriction ***GI/GU:*** GI upset ***Skin:*** tissue necrosis with extravasation
Onset	< 5 minutes *(peak 5-8 minutes)*
Duration	< 10 minutes *(half-life 2 minutes)*
Dose	*Adult & Pediatric*: 2-20mcg/kg/min
Preparation[48]	400mg in 250ml NS or D5W (yields 1.6mg/ml or 1600mcg/ml)

[46] Barringer Group, LLC (2019)
[47] Barringer Group, LLC (2019)
[48] Confirmed in Barringer Group, LLC (2019)

Epinephrine	
Class	Sympathomimetic, adrenergic stimulant
Mechanism of Action	Directly stimulates alpha- and beta-adrenergic receptors in the sympathetic nervous system. Relaxes bronchial smooth muscle, stimulates cardiac muscle, and dilates skeletal muscle vasculature.
Indications	Shock & Hypotension: to increase cardiac output Croup: to relieve subglottic edema Bronchospasm: to cause bronchodilation Allergic Reaction: to cause bronchodilation, relieve airway edema and increase vascular tone Dysrhythmia & Management of the Newborn: to increase HR with bradycardia Cardiac Arrest: to increase chance of ROSC[49] Rapid Sequence Intubation: to mitigate hypotensive state and inadequate perfusion during the procedure
Absolute Contraindications	None in the emergent setting
Precautions	Use caution with concurrent: • Cardiovascular disease (can increase myocardial oxygen demand) • Hypertension (can worsen hypertensive state) • Tahchydysrhythmia (can increase HR) • Bicarbonate use (can become deactivated) • Sympathomimetic use (toxicity may be enhanced) Higher doses may be required with hypotension due to phenothiazine use[50] or concurrent use of alpha- and/or beta-blockers Should be protected from light **Pregnancy Category C**
Adverse Effects	***Neurologic:*** anxiety, headache, dizziness, weakness, cerebral hemorrhage ***Respiratory:*** pulmonary edema ***Cardiovascular:*** arrythmia, tachycardia, palpitations, angina, hypertension ***GI/GU:*** GI distress, nausea, vomiting ***Musculoskeletal:*** tremors ***Skin:*** pallor, diaphoresis, tissue necrosis (with IM/ SQ administration)
Onset	< 2 minutes *(peak < 5 minutes)*
Duration	5-10 minutes *(half-life 5 minutes)*

[49] Verkest & Jarvis (2019)
[50] Such as Prochlorperazine

Dose	***Respiratory*** (Allergic Reaction, Bronchospasm) *1:1000 (1mg/ml)* *Adult:* 0.3mg IM, repeat as needed [0.3ml] *Pediatric:* 0.01mg/ml (max 0.3ml), repeat as needed to 3 total doses [0.01ml/kg] *1:10,000 (0.1mg/ml)* *Adult:* 0.1-0.5mg IV over 2-5min, repeat as needed [1-5ml] *Pediatric:* 0.01mg/kg IV (max 0.5mg) over 2-5min, repeat as needed [0.1ml/kg] ***Croup*** *Racemic Epinephrine* *Adult & Pediatric:* 1.25mg NEB, repeat as needed ***Bradycardia*** (to include Management of the Newborn) *1:10,000 (0.1mg/ml)* *Adult:* 2-20mcg/min or 0.1-0.5mcg/kg/min (max 20mcg/min) *Pediatric:* 0.01mg/kg IV, repeat as needed [0.1ml/kg] ***Cardiac Arrest*** *1:10,000 (0.1mg/ml)* *Adult:* 1mg IV, repeat as needed *Pediatric:* 0.01mg/kg IV, repeat as needed [0.1ml/kg] ***Shock, Hypotension, Rapid Sequence Intubation*** *Infusion* (Shock, Hypotension) *Adult:* 2-20mcg/min or 0.1-0.5mcg/kg/min (max 20mcg/min) *Pediatric:* 0.1-1mcg/kg/min *Push Dose Pressor* (Shock, Rapid Sequence Intubation) *Adult:* 5-20mcg IV, repeat as needed *Pediatric:* 5-10mcg IV, repeat as needed
How to Mix	***Infusion*** 1mg Epinephrine in 100ml fluid (yields 10mcg/ml) *-or-* 4mg Epinephrine in 250ml fluid (yields 16mcg/ml)[51] 1mg of Epinephrine is either 1amp of 1:10,000 (10ml) or 1 vial 1:1,000 (1ml) ***Push Dose Pressor*** 1ml 1:10,000 in 9ml NS (yields 10mcg/ ml)

[51] Barringer Group, LLC (2019)

Etomidate	
Class	Sedative/hypnotic, anesthetic
Mechanism of Action	It is an ultra-short-acting, nonbarbiturate hypnotic, with no analgesic effects, used for facilitated intubation. It produces a rapid induction of anesthesia with minimal cardiovascular and respiratory effects. It is rapidly distributed following IV injection or infusion and rapidly metabolized and excreted. Unlike other short-acting induction anesthetics, particularly barbiturates, it does not cause histamine release. Its effects on the cardiovascular and respiratory systems are minimal, and there are no reports of organ toxicity, or biochemical or hematological disturbances.
Indications	Pain, Agitation & Sedation: to treat agitation and/ or provide sedation Rapid Sequence Intubation: to induce sedation prior to airway management
Absolute Contraindications	None in the emergency setting
Precautions	Use caution with concurrent:[52] • Asthma[53] (due to risk of laryngospasm) • Hypotension (can cause further drop in BP)[54] • Cardiovascular disease[55] (can cause dysrhythmia and hemodynamic changes) • Adrenal suppression (i.e. sepsis – can further depress adrenal function)[56] **Pregnancy Category C**
Adverse Effects	***Respiratory:*** apnea, laryngospasm ***Cardiovascular:*** hypertension and hypotension, bradycardia and tachycardia ***GI/GU:*** nausea, vomiting ***Musculoskeletal:*** myoclonic skeletal muscle movement
Onset	10-20 seconds *(peak < 1 minute)*
Duration	3-5 minutes *(half-life 30-70 minutes)*
Dose	***Agitation/ Sedation*** *Adult:* 10mg IV once *Pediatric:* 0.3mg/kg (max 10mg) IV once ***RSI*** *Adult & Pediatric:* 0.3mg/kg (max 40mg) IV

[52] List comes from Blesdoe & Clayden (2019) and [redacted] explanations are as cited below

[53] Can't find a better explanation for this one – could be simply that Ketamine is preferred in RSI with Asthma and not an actual contraindication?

[54] PDR Network (2018)

[55] Can't find a better explanation for this one either

[56] PDR Network (2018)

Fentanyl	
Class	Narcotic analgesic, anesthetic
Mechanism of Action	Fentanyl is a potent synthetic narcotic agonist analgesic with pharmacologic actions qualitatively similar to those of morphine and meperidine, but whose action is more prompt and less prolonged. Its principal actions are analgesia and sedation. Drug induced alterations in respiratory rate and alveolar ventilation may persist beyond the analgesic effect. The emetic effect is less than with either morphine or meperidine.
Indications	Pain, Agitation & Nausea: to relieve severe pain or maintain analgesia
Absolute Contraindications	None in the emergent setting
Precautions	Can cause (and often worse with other CNS depressants): • Respiratory depression (Naloxone should be available) • Hypotension (therefore use caution with shock or sever hemorrhage) Chest wall rigidity may occur with rapid administration **Pregnancy Category C**
Adverse Effects	***Neurologic:*** sedation, euphoria, dizziness, delirium, convulsions (with high doses), miosis, blurred vision ***Respiratory:*** laryngospasm, bronchoconstriction, respiratory depression or arrest ***Cardiovascular***: hypotension, bradycardia, circulatory depression, cardiac arrest ***GI/ GU:*** nausea (although to less of an effect that morphine), vomiting, constipation, ileus, urinary retention
Onset	Immediate *(peak 3-5 minutes)*
Duration	30-60 minutes *(half-life 6-8 hours)*
Dose	*Adult*: 0.5-1mcg/kg (max 100mcg) IV/IM/IN, repeat as needed *Pediatric*: 0.5-1mcg/kg (max 100mcg) IV/IM/IN, repeat as needed *Infusion*: 1-2mcg/kg/hr, titrated to effect[57]
How to Mix	250mcg in 50ml NS or D5W (yields 5mcg/ml) -or- 1mg in 100ml NS or D5W (yields 10mcg/ml)[58]

[57] Dose cited by Barringer Group, LLC (2019) is 25-250mcg/hr and roughly in line with this weight-based dose, makes sense to keep it weight based in my opinion though (since we do the push doses by weight)

[58] Barringer Group, LLC (2019)

Furosemide	
Class	Potent loop diuretic
Mechanism of Action	Inhibits sodium and chloride reabsorption in the proximal part of the ascending loop of Henle. This promotes the excretion of sodium, water, chloride and potassium. Also may cause temporary increase in glomerular filtration rate and a decrease in peripheral vascular resistance.
Indications	Congestive Heart Failure/ Pulmonary Edema & Management of the Sick Baby: to cause diuresis with fluid overload
Absolute Contraindications	• Anuria • Non-hemorrhagic hypovolemic shock
Precautions	Use caution with concurrent: • Dehydration/ fluid depletion (can exacerbate electrolyte disturbance) • Electrolyte disturbance or depletion (can be exacerbated by fluid loss and metabolic alkalosis) • Antihypertensive use (various different drug interactions with many different types of antihypertensives)[59] • Pregnancy (due to no good evidence regarding efficacy and safety, potential for damage to fetus) • Liver disease (increased risk of toxicity and delayed metabolism) Should be protected from light **Pregnancy Category C**
Adverse Effects	***Neurologic:*** transient deafness (with rapid IV administration) ***Cardiovascular:*** volume depletion, orthostatic hypotension, transient thrombocytopenia ***GI/GU:*** GI distress ***Endocrine/ metabolic:*** electrolyte shifts (hypochloremia, hypocalcemia, hypokalemia, hypomagnesemia, hyponatremia) ***Lymphatic/ Immune:*** transient leukopenia
Onset	5-10 minutes (vasodilation), 5-30 minutes (diuresis)
Duration	2 hours (vasodilation), 6 hours (diuresis) (*half-life 30 minutes)*
Dose	*Adult:* 1mg/kg (max 160mg) IV, once; or match patient's PO dose *Pediatric:* 1mg/kg IV, once

[59] Best I could come up with, from PDR Network (2018)

Heparin	
Class	Anticoagulant (unfractionated)
Mechanism of Action	Accelerates formation of antithrombin III – thrombin complex, inactivates thrombin and prevents conversion of fibrinogen to fibrin. Heparin does not lyse already existing thrombi but may prevent their extension and propagation. It also inhibits the formation of new clots.
Indications	Pulmonary Embolism & Acute Coronary Syndrome: to inhibit extension and propagation of clots Other Uses: any condition caused by a blood clot (DVT, arterial occlusion, ACS, ischemic CVA, PE, etc.) or with a propensity to develop a clot
Absolute Contraindications[60]	• Hypersensitivity to beef or pork products • Active bleeding (except DIC) • Thrombocytopenia
Precautions	Use caution with concurrent:[61] • Old age (increased sensitivity to effects, consider lower dose) • Increased risk of bleeding, recent surgery or invasive procedure, peptic ulcer disease or history of GI bleed, bleeding tendencies (can cause or worsen bleeding) • Renal dysfunction (increased risk for coagulopathy) **Pregnancy Category C**
Adverse Effects	***Neurologic:*** confusion, dizziness ***Cardiovascular:*** prolonged clotting times, hemorrhage, thrombocytopenia, edema
Onset	Immediate *(peak 2-3 minutes)*
Duration	2-6 hours *(half-life 90 minutes)*
Dose	*Adult:* 5000u IV, once; followed by infusion of 1000u/hr *Pediatric:* not indicated for pediatric patients
How to Mix	5000u in 250 NS or D5W (yields 20u/ml) At this concentration, 1000u/hr is 50ml/hr

[60] Neonates or premature infants listed in contraindications, but we aren't giving it to kids anyways

[61] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)

Hydralazine	
Class	Antihypertensive, potent peripheral vasodilator
Mechanism of Action	Directly vasodilates vascular smooth muscle, lowering blood pressure. Effects more pronounced on arterial than venous system.
Indications	Stroke, Hypertension, Traumatic Brain Injury, Pregnancy Induced Hypertension, (Pre-)Eclampsia, HELLP Syndrome: to decrease blood pressure with risk of organ damage
Absolute Contraindications	• Patients with a known history of coronary artery disease • Rheumatic heart disease involving the mitral valve
Precautions	Use caution with concurrent:[62] • Cardiovascular disease or ACS (can increase pulmonary artery pressure and cause reflex tachycardia, may lead to ischemia or worsening ischemia) • Old age (metabolism may be delayed, consider smaller dose) • History of stroke[63] • Impaired renal function (due to hepatic metabolism) **Pregnancy Category C**
Adverse Effects	***Neurologic:*** headache ***Cardiovascular:*** tachycardia, palpitations, angina, peripheral edema ***GI/GU:*** nausea and vomiting, diarrhea, GI distress ***Skin:*** rash, flushing ***Lymphatic/ Immune:*** neutropenia, lupus-like syndrome
Onset	5-15 minutes (IV); 10-40 minutes (IM) *(peak <80 minutes)*
Duration	2-6 hours *(half-life 2-8 hours)*
Dose	*Adult:* 10mg IV/ IM, repeat as needed to 4 total doses *Pediatric:* 0.2-0.6mg/kg IV/IM, once

[62] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)
[63] Need to find a good reason for this one

Ipratropium	
Class	Anticholinergic
Mechanism of Action	Ipratropium decreases mucus production in bronchial smooth muscle and causes mild bronchodilation by inhibiting cholinergic receptors in bronchial smooth muscle.
Indications	Bronchospasm: to cause bronchodilation and decrease mucus production with reversable etiology (i.e. asthma, COPD, allergic reaction)
Absolute Contraindications	None
Precautions	Should not be the primary medication for the acute treatment of bronchospasm (due to delayed onset of action) **Pregnancy Category B**
Adverse Effects	***Neurologic:*** dizziness, anxiety, headache, nervousness, blurred vision ***Respiratory:*** paradoxical bronchospasm, cough ***Cardiovascular:*** palpitations, chest pain ***GI/GU:*** dry mouth, GI distress ***Skin:*** rash
Onset	Varies (*peak 1.5-2 hours)*
Duration	4-6 hours (*half-life 1.5-2 hours)*
Dose	*Adult:* 0.5mg NEB, may repeat up to 3 total doses *Pediatric:* 0.5mg NEB, once

Ketamine	
Class	Sedative/hypnotic, analgesic, dissociative anesthetic
Mechanism of Action	A rapid-acting general anesthetic producing an anesthetic state characterized by profound analgesia, normal pharyngeal-laryngeal reflexes, normal or slightly enhanced skeletal muscle tone, cardiovascular and respiratory stimulation, and occasionally a transient and minimal respiratory depression.
Indications	Pain, Agitation & Nausea: to treat pain and/ or maintain analgesia Rapid Sequence Intubation: to induce sedation prior to airway management Field Amputation: to both treat pain and induce a dissociative state Other uses: to maintain bronchodilation in ventilated patients
Absolute Contraindications	Significantly elevated blood pressure
Precautions	Use caution with concurrent: • Potential for increased ICP (can worsen ICP) • Coronary Artery disease (can increase myocardial demand) • Old age (effects may be potentiated, consider lower dose)[64] Should be given slowly over 60 seconds (rapid administration has been associated with respiratory depression) Emergence reactions and/ or hallucinations may occur, less so with minimization of sensory and tactile stimuli during the recovery period **Pregnancy Category Unknown**
Adverse Effects	***Neurologic:*** hallucinations, diplopia and nystagmus, increased intraocular pressure ***Respiratory:*** increased RR and TV, laryngospasm ***Cardiovascular:*** increased HR and BP (and less often hypotension and bradycardia) ***GI/GU:*** anorexia, nausea, vomiting ***Musculoskeletal:*** increased skeletal muscle tone (occasionally mimics seizures)
Onset	<1 minute (IV), <5 minutes (IM) *(peak variable)*
Duration	10-15 minutes (IV), 20-30 minutes (IM) *(half-life 1-2 hours)*
Dose	***Pain*** *Adult & Pediatric*: 0.1-0.25mg/kg, repeat as needed ***Agitation/ Sedation*** *Adult:* 0.5-1mg/kg IV or 4mg/kg IM, repeat as needed *Pediatric:* 0.5-1mg/kg IV/ IM, repeat as needed ***RSI & Field Amputation*** *Adult & Pediatric:* 1-2mg/kg IV

[64] PDR Network (2018)

Labetalol	
Class	Antihypertensive, Beta Blocker
Mechanism of Action	Combines both selective, competitive alpha-adrenergic blocking and non-selective, competitive, beta-blocking activity in a single substance. The ratio of alpha- to beta-blocking has been estimated at 1:7 following intravenous administration. Due to the alpha-1 receptor blocking activity of labetalol, blood pressure is lowered more in the standing patient than in the supine patient, and symptoms of postural hypotension can occur.
Indications	Stroke & Hypertension: to decrease blood pressure with risk of organ damage
Absolute Contraindications	None in the emergent setting
Precautions	Use caution with concurrent:[65] • Asthma or COPD (can inhibit bronchodilation) • History of heart failure or CHF (negative inotropic effect can decrease cardiac output) • Pheochromocytoma (can cause paradoxical hypertension) • Impaired hepatic function or jaundice (hepatic metabolization, consider • Diabetes mellitus (can clock signs of hypoglycemia, enhance hypoglycemia and/ or cause hypertension) • Peripheral vascular disease[66] **Pregnancy Category C**
Adverse Effects	***Neurologic:*** fatigue, headache, paresthesia, syncope ***Respiratory:*** bronchospasm, nasal stuffiness ***Cardiovascular:*** bradycardia, heart block, congestive heart failure, postural hypotension, ventricular dysrhythmias ***GI/GU:*** urinary retention ***Musculoskeletal:*** muscle spasm ***Skin:*** rash ***Reproductive:*** sexual dysfunction
Onset	2-5 minutes *(peak 5-15 minutes)*
Duration	2-4 hours *(half-life 3-8 hours)*
Dose	*Adult:* 20mg IV over 2-5min, may repeat q10min at 40mg, then 80mg; after that, proceed to another antihypertensive *Pediatric:* 0.2-1mg/kg IV (max 20mg), repeat as needed at twice previous dose for total of three doses[67] *Infusion:* 0.25-3mg/kg/hr[68]
How to Mix	200mg in 100ml NS or D5W (yields 2mg/ml)

[65] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)
[66] Need to find a good reason for this one
[67] PDR Network (2018)
[68] PDR Network (2018): this is a pediatric dose, adult dose is normally 0.5-2mg; single dose listed for simplicity, but we can modify if need be

Lidocaine	
Class	Antiarrhythmic (Class IB[69]), local anesthetic
Mechanism of Action	Lidocaine suppresses automaticity and depolarization of the ventricles during diastole by modifying the flux of sodium channels in the myocardium, thus controlling ventricular arrythmia.[70] Lidocaine is also a local anesthetic.
Indications	Pediatric Cardiac Arrest: to convert ventricular dysrhythmias IO Insertion, Chest Tube Insertion, Field Amputation: to provide local anesthesia with invasive procedures
Contraindications	Stoke-Adams Syndrome, Wolf-Parkinson-White Syndrome, severe heart blocks
Precautions	Use caution with concurrent: • Liver disease, CHF and old age (decreased metabolization can cause toxicity[71]) • Marked hypoxia or respiratory depression (can exacerbate symptoms) • Atrial fibrillation or atrial flutter (may increase ventricular rate) **Pregnancy Category B**
Adverse Effects	***Neurologic:*** nervousness, apprehension, lightheadedness, euphoria, confusion, dizziness, blurred vision ***Respiratory:*** respiratory depression or arrest ***Cardiovascular:*** bradycardia, hypotension, cardiovascular collapse ***GI/GU:*** vomiting ***Musculoskeletal:*** twitching, tremors, convulsions ***Skin:*** flushing
Onset	Immediate
Duration	10-20min *(peak 7-120min)*

[69] PDR Network (2018)
[70] Barringer Group, LLC (2019)
[71] PDR Network (2018)

Dose	***Pediatric Cardiac Arrest*** *2% Cardiac Pre-Fill* Loading Dose: 1mg/kg IV, repeat once if maintenance infusion not started within 15min of initial bolus dose Maintenance Infusion: 20-50mcg/kg/min ***IO Insertion***[72] *2% Cardiac Pre-Fill* *Adult:* 40mg (2ml) *Pediatric:* 0.5mg/kg, not to exceed 40mg (2ml) 1. Prime EZ-IO extension set with lidocaine (approx. 1ml) 2. Slowly infuse remaining dose over 120 seconds 3. Allow lidocaine to dwell in IO space for 60 seconds 4. Flush with 5-10ml NS 5. Administer an additional dose (half of initial dose) over 60 seconds as needed ***Invasive Procedure*** (Chest Tube Insertion, Field Amputation) *1% Solution* 20ml, injected locally at site
How to Mix	100mg in 50ml NS or D5W (yields 2mg/ml) -or- 100mg in 250ml NS or D5W (yields 0.4mg/ml)

[72] Teleflex (2019)

Magnesium Sulfate	
Class	Anticonvulsant, antidysrhythmic, electrolyte replenisher, tocolytic
Mechanism of Action[73]	Magnesium effects various electrolyte and enzyme pathways in a variety of cell types including the myocardium, bronchial tree, skeletal and smooth muscle by reducing the release of acetylcholine at the neuromuscular junction reducing muscle contractions and promoting muscle relaxation.
Indications	Bronchospasm: to cause bronchodilation Dysrhythmia: to convert polymorphic ventricular tachycardia (Torsade's) Electrolyte Abnormalities: to replace magnesium PIH, (Pre-)Eclampsia & HELLP, Preterm Labor: to induce tocolysis/ postpone delivery of a fetus
Absolute Contraindications	• Hypermagnesemia • Hypocalcemia • Anuria • Heart blocks
Precautions	Use caution with concurrent: • Digitalis use (can lead to heart block[74]) • Renal failure or impairment (renal excretion, increased risk for toxicity[75]) • Myasthenia gravis (can exacerbate symptoms[76]) • Shock (can cause hypotension and circulatory collapse[77]) • Persistent hypertension[78] Calcium chloride should be readily available as an antidote if respiratory depression ensues, consider monitoring deep tendon reflexes **Pregnancy Category D**[79]
Adverse Effects	***Neurologic:*** drowsiness, sedation, confusion, depressed or absent reflexes, hypothermia ***Respiratory:*** respiratory depression ***Cardiovascular:*** hypotension, circulatory collapse, cardiac depression, heart block, circulatory collapse ***GI/GU:*** extreme thirst ***Musculoskeletal:*** muscle weakness ***Skin:*** flushing, diaphoresis ***Endocrine/ Metabolic:*** hypocalcemia
Onset	Immediate (IV/IO), 1 hour (IM) *(peak variable)*
Duration	1 hour

[73] Barringer Group, LLC (2019)
[74] Fresenius Kabi (2016)
[75] PDR Network (2019)
[76] Fresenius Kabi (2016)
[77] Fresenius Kabi (2016)
[78] Need to verify this one, can't find anything good to justify it
[79] Was changed from Category A to Category D in 2016; American (2016)

Dose	***Bronchospasm & Hypomagnesemia*** *Adult:* 2g IV over 20min, repeat as needed *Pediatric:* 50mg/kg (max 2g) IV over 20min, repeat as needed ***Torsades de Pointes***[80] *Non-Perfusing* *Adult:* 1-2g IV diluted in NS and over 5min, once *Pediatric:* 25-50mg/kg (max 2g) IV diluted in NS and over 5min, once *Perfusing* *Adult:* 1-2g IV diluted in NS and given over 30min; followed by infusion at 0.5-1g/hr with conversion *Pediatric:* 25-50mg/kg (max 2g) IV diluted in NS and given over 30min, once ***Obstetrics*** 4g IV over 20min loading dose 2-4g/hr maintenance infusion

[80] ACLS (2015); PALS (2015); although time parameters vary slighty ("slowly" and "5-60min")

Mannitol	
Class	Osmotic diuretic
Mechanism of Action[81]	Mannitol mobilizes excess fluid in oliguric renal failure or edema, reduces ICP and IOP, increases urinary excretion of toxic materials by increasing the osmotic pressure of the glomerular filtrate, thereby inhibiting reabsorptions of water and electrolytes. Causes excretion of H2O, NA, K, Cl, PhO4, MG and uric acid.
Indications	Altered Mental Status, Stroke, Traumatic Brain Injury: to reduce ICP and reverse/ prevent cerebral edema Other uses: blood transfusion reactions
Absolute Contraindications	• Severe dehydration • Pulmonary edema
Precautions	Rapid administration can cause circulatory overload Crystallization of the medication can occur at lower temperatures An inline filter should be used **Pregnancy Category C**[82]
Adverse Effects	***Respiratory:*** pulmonary congestion ***Cardiovascular:*** transient volume overload ***Endocrine/ Metabolic:*** sodium depletion
Onset	15 minutes *(peak 3-8 hours)*
Duration	Varies *(half-life 100 minutes)*
Dose	*Adult & Pediatric:* 1g/kg IV over 10min (use filter)

[81] Barringer Group, LLC (2019)
[82] Barringer Group, LLC (2019)

Methylprednisolone	
Class	Corticosteroid
Mechanism of Action[83]	Methylprednisolone suppresses inflammation and immune response, regulating gene expression by binding to receptors in the nucleus-modifying transcription at the cellular level. These effects control potent mediators of inflammation such as prostaglandins and leukotrienes which inhibit the release of arachidonic acid, thus suppressing inflammation by decreasing capillary permeability.
Indications	Epiglottitis & Bronchospasm: to reduce inflammation and ease work of breathing Spinal Cord Injury: to reduce swelling in the spinal column[84] Other uses: drug hypersensivity reactions, acute exacerbations of multiple sclerosis, acute rheumatic disorders, acute adrenal insufficiency
Absolute Contraindications	Premature infancy
Precautions	Use caution with concurrent: • Hypertension (can be exacerbated)[85] • Hyperglycemia (can cause an increase in BGL)[86] • Fungal infection (can decrease the body's immune response)[87] **Pregnancy Category C**
Adverse Effects[88]	***Neurologic:*** increased ICP, vertigo, convulsions, headache ***Cardiovascular:*** fluid retention, CHF in susceptible patients, hypertension ***GI/GU:*** gastrointestinal bleeding, peptic ulcer with possible perforation, pancreatitis, abdominal distention ***Musculoskeletal:*** muscle weakness, loss of muscle mass, pathologic fracture of long bones, osteoporosis, vertebral compression fractures ***Skin:*** impaired wound healing, increased sweating, petechiae, thin and fragile skin ***Endocrine/ Metabolic:*** sodium retention, potassium loss, hypokalemic alkalosis ***Lymphatic/ Immune:*** suppression of natural steroids
Onset	Varies *(peak 4-8 days)*
Duration	1-5 weeks *(half-life 3.5 hours)*

[83] Barringer Group, LLC (2019)
[84] Bracken (2012)
[85] Barringer Group, LLC (2019)
[86] Barringer Group, LLC (2019)
[87] All infections or just fungal?
[88] Which of these apply to use in our setting? - many seem to relate to long term/ daily use

Dose	***Respiratory*** (Epiglottitis & Bronchospasm) *Adult*: 125mg IV/IM, once *Pediatric*: 2mg/kg IV/IM (max 125mg) IV, once[89] ***Spinal Cord Injury*** *Adult:* 1g IV over 20min, loading dose *Pediatric:* 30mg/kg (max 1g) over 20min, loading dose *Infusion:* 5.4mg/kg/hr for 23 hours (start 45min after loading dose)
How to Mix	1g (8 vials) in 100ml or 250ml NS

[89] Confirmed by Barringer Group, LLC (2019)

Metoprolol	
Class	Sympathetic blocker (β_1 selective), class II antidysrhythmic
Mechanism of Action	Competitive antagonism of catecholamines at peripheral (especially cardiac) adrenergic neuron sites, leading to a decrease in cardiac output. Chiefly cardiac muscle selective but can inhibit beta-2 adrenoreceptors in the bronchial and vascular musculature. Also causes a centralized effect leading to reduced sympathetic outflow to the periphery and suppression of renin activity.
Indications	Acute Coronary Syndrome: to decrease myocardial oxygen demand Dysrhythmia: refractory stable narrow complex tachycardias Endocrine Disorders: for tachycardia related to hyperthyroidism Other: to decrease heart rate in a dissecting aortic aneurysm
Absolute Contraindications	• Severe bradycardia (sinus bradycardia, heart block greater than first degree, heart rate less then 45 bpm) • Hypotension, shock, overt cardiac failure • Active bronchospasm
Precautions	Use caution with concurrent[90]: • History of asthma or COPD (can inhibit bronchodilation) • Impaired hepatic or renal function (reduced clearance, consider smaller doses) • Cardiomegaly, CHF with digitalis and/or diuretic use (depresses cardiac output) • Thyrotoxicosis (although indicated, know that metoprolol can mask the signs) • Diabetes mellitus (can prolong or enhance hyperglycemia) • Peripheral vascular disease (decreased CO can exacerbate symptoms) **Pregnancy Category C**
Adverse Effects	***Neurologic:*** tiredness, dizziness ***Respiratory:*** bronchospasm ***Cardiovascular:*** bradycardia, heart block, congestive heart failure, hypotension, peripheral edema ***GI/GU:*** diarrhea
Onset	Immediate *(peak 20 minutes)*
Duration	5-8 hours *(half-life 3-4 hours)*
Dose	***Acute Coronary Syndrome***[91] *Adult:* 5-10mg IV once *Pediatric:* not indicated ***Stable Narrow-QRS Tachycardia***[92] (and tachycardia related to Hyperthyroidism[93]) *Adult:* 5mg IV, repeat as needed to 3 total doses *Pediatric:* not indicated

[90] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)
[91] Fresenius Kabi (2013); specifies 5mg up to three times, however additional guidance per [redacted] Medical Director
[92] Barringer Group, LLC (2019); refers to "SVT"
[93] Propanolol would be preferred, but Metoprolol also effective; AMLS (2017); Murchison, et al. (1979); Campbell & Doogue (2012)

Midazolam	
Class	Tranquilizer, benzodiazepine
Mechanism of Action	Midazolam is a short-acting parenteral benzodiazepine with CNS depressant, muscle relaxant, anticonvulsant, and anterograde amnestic effects. Facilitates the action of gamma aminobutyric acid to provide a short acting CNS depressant action. Like the other benzodiazepines, it has no effect on pain.
Indications	Pain, Agitation & Nausea: to induce or maintain sedation and mitigate agitation Seizure: to prevent or stop seizure activity
Absolute Contraindications	• Hypotension or shock • Intolerance to benzodiazepines • Acute narrow angle glaucoma • Acute alcohol intoxication
Precautions	Use caution with concurrent: • Old age, severe liver disease or renal failure (metabolization may be impaired, effects may last longer than expected) • CHF (can decrease respiratory function) Dilute with normal saline or D_5W prior to intravenous administration Respiratory depression more common with midazolam than with other benzodiazepines **Pregnancy Category D**
Adverse Effects	***Neurologic:*** drowsiness, amnesia, euphoria, confusion, ataxia, slurred speech, paresthesia, sedation, blurred vision, nystagmus, miosis, ***Respiratory:*** respiratory depression, apnea, laryngospasm, bronchospasm ***Cardiovascular:*** hypotension, tachycardia ***GI/GU:*** GI distress ***Skin:*** hives, pruritis, injection site irritation
Onset	3-5 minutes (IV), 15 minutes (IM) *(peak 20-60 minutes)*
Duration	< 2 hours (IV), 1-6 hours (IM) *(half-life 1-4 hours)*
Dose	*Adult:* 2.5-5mg IV/IM/IN, repeat as needed *Pediatric:* 0.05-0.1mg/kg (max 5mg) IV/IM/IN, repeat as needed

Morphine	
Class	Narcotic analgesic
Mechanism of Action	Acts on opiate receptors to alter perception of pain, also has a depressant effect on CNS centers for breathing and on the cough reflex center
Indications	Pain, Agitation & Nausea: to relieve pain or maintain analgesia
Absolute Contraindications	• Head injury • Volume depletion
Precautions	Can cause respiratory depression (potentiated by rapid IV administration) May have more of an effect with the very old, very young or debilitated patients **Pregnancy Category C**
Adverse Effects	***Neurologic:*** dizziness, sedation, euphoria ***Respiratory:*** respiratory depression ***Cardiovascular:*** tachycardia, bradycardia, hypertension, hypotension ***Skin:*** rash, pruritis ***GI/GU:*** biliary spasm, nausea, vomiting, constipation, ileus
Onset	Immediate (IV); 15-30 minutes (IM) *(peak 20 minutes (IV); 30*-60 minutes (IM))
Duration	2-7 hours *(half-life 1-7 hours)*
Dose	*Adult*: 2-5mg IV/IM, repeat as needed *Pediatric*: 0.1mg/kg IV/IM, repeat as needed

Naloxone	
Class	Narcotic antagonist
Mechanism of Action	Naloxone, an analog of oxymorphone, is a pure narcotic antagonist, essentially free of agonistic (morphine-like) properties. This it produces no significant analgesia, respiratory depression, psychotomimetic effects, or miosis when administered in the absence of narcotics and possesses more potent narcotic antagonist action. Naloxone competes for and displaces narcotic molecules from opiate receptors in the brain and it antagonizes the action of narcotic analgesics on opiate receptors in the CNS.
Indications	Altered Mental Status, Toxic Exposure: to reverse the effects of narcotic/ opiate overdose
Absolute Contraindications	None
Precautions	May cause withdrawal effects in patients dependent on narcotics Adverse effects may be exacerbated by rapid administration Duration of action is shorter than most narcotics (therefore subsequent doses may be required). **Pregnancy Category B**
Adverse Effects	***Neurologic:*** agitation ***Respiratory:*** pulmonary edema ***Cardiovascular:*** tachycardia, hypertension ***GI/GU:*** nausea, vomiting ***Skin:*** diaphoresis
Onset	< 2 minutes (IV/IO); 2-10 minutes (IM/ET) *(peak same as onset)*
Duration	20-120 minutes *(half-life 60-90 minutes)*
Dose	*Adult*: 0.4-2mg IV/IM/IN, repeat as needed *Pediatric*: 0.1mg/kg (max 2mg) IV/IM/IN, repeat as needed

Nitroglycerin	
Class	Antianginal, nitrate
Mechanism of Action	Relaxes vascular smooth muscle both in venous and arterial beds causing a decrease in myocardial oxygen consumption, reduction in afterload and preload. Also dilates coronary vessels. Therapeutic doses may reduce systolic, diastolic and mean blood pressure; hear rate is usually slightly increased.
Indications	Acute Coronary Syndrome: to reduce preload and afterload to decrease myocardial oxygen demand Congestive Heart Failure/ Pulmonary Edema: to reduce blood pressure and reduce afterload to decrease myocardial oxygen demand
Absolute Contraindications	Hypotension (SBP <90)
Precautions	Use caution with concurrent:[94] • Head injury or cerebral hemorrhage (can increase ICP with due to vasodilation) • Hypovolemia, hypotension, right ventricular infarction (also any other preload dependent state or murmur indicative of aortic stenosis – can decrease CO to cause a precipitous drop in BP) Medication must be protected from light, expires quickly once bottle is opened **Pregnancy Category C**
Adverse Effects	***Neurologic:*** dizziness, headache ***Cardiovascular:*** hypotension, postural hypotension, bradycardia, tachycardia, methemoglobinemia ***Skin:*** flushing, burning oral sensation (with SL administration)
Onset	1-3 minutes (SL) *(peak 5-10 minutes (SL)*
Duration	20-30 minutes (SL) *(half-life 1-4 minutes)*
Dose	***Acute Coronary Syndrome*** *Adult:* 0.4mg SL, may repeat as needed to 3 total doses *Pediatric:* not indicated *Infusion:* 5-200mcg/min ***CHF/ Pulmonary Edema*** *Adult:* 0.4mg SL, may repeat as needed *Pediatric:* not indicated *Infusion:* 40-200mcg/min
How to Mix	50mg in 250ml D5W[95] (yields 200mcg/ml) Initial infusion at 5mcg/min is 1.2ml/hr Initial infusion at 40mcg/min is 9.6ml/hr

[94] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)
[95] Barringer Group, LLC (2019)

Norepinephrine	
Class	Sympathomimetic, adrenergic vasopressor
Mechanism of Action	Directly stimulates alpha adrenergic receptors resulting in constriction of all vessels and an increase in peripheral vascular resistance; increase in systolic and diastolic blood pressure; decreased blood flow to vital organs, skin and muscle. Directly stimulates Beta-1 receptors with a positive inotropic effect.
Indications	Shock, Hypotension: to increase systemic vascular resistance
Absolute Contraindications	• Hypotensive states due to hypovolemia • Peripheral or mesenteric vascular thrombosis
Precautions	Use caution with profound hypoxia or hypercapnia[96] Can be deactivated by alkaline solutions Extravasation can cause tissue necrosis May cause reaction in patients allergic to sulfites **Pregnancy Category D**
Adverse Effects	***Neurologic:*** anxiety, headache, weakness, dizziness, cerebral hemorrhage, seizures, hyperthermia ***Respiratory:*** dyspnea, apnea ***Cardiovascular:*** hypertension, severe peripheral and visceral vasoconstriction, arrhythmias, palpitations ***GI/ GU:*** GI distress, decreased urine output ***Skin:*** necrosis with extravasation, pallor ***Endocrine:*** metabolic acidosis, hyperglycemia
Onset	Immediate *(peak < 1 minute)*
Duration	1-2 minutes *(half-life 3 minutes)*
Dose	*Adult:* 2-30mcg/min or 0.1-5mcg/kg/min *Pediatric:* 0.05-2mcg/kg/min
How to Mix	4 or 8mg in 250ml D5W (yields 16mcg/ml or 32mcg/ml)

[96] Find a specific reason

Ondansetron	
Class	Antiemetic
Mechanism of Action[97]	Ondansetron decreases the incidence and severity of nausea and vomiting by selectively binding to serotonin 5-HT3 receptors (selective antagonist) located in vagal nerve terminals and chemoreceptor trigger zone in the CNS
Indications	Pain, Agitation & Nausea: to prevent or reduce severity of nausea and vomiting
Absolute Contraindications	None
Precautions	Use caution with concurrent: • Use of serotonin blockers (therapeutic effect may be inhibited) • Liver disease (hepatic metabolization[98]) **Pregnancy Category B**
Adverse Effects	***Neurologic:*** headache, lightheadedness, dizziness, akathisia, acute dystonic reactions, seizures ***Respiratory:*** bronchospasm ***Cardiovascular:*** tachycardia, angina ***GU/GI:*** diarrhea, constipation ***Skin:*** rash ***Endocrine/ Metabolic:*** hypokalemia
Onset	10-30 minutes *(peak 1.5 hours)*
Duration	8 hours (*half-life 3 hours)*
Dose	*Adult:* 0.4mg IV/IM/SL, may repeat once *Pediatric:* 0.1mg/kg (max 4mg) IV/IM or 2mg SL, may repeat once

[97] Barringer Group, LLC (2019)
[98] PDR Network (2018)

Oxytocin	
Class	Hormone, oxytocic
Mechanism of Action	Increases the sodium permeability of uterine myofibrils, stimulating the contraction of uterine smooth muscle
Indications	Vaginal Bleed: postpartum vaginal bleeding
Contraindications	• Prior to delivery of baby and placenta • Cesarean section (current pregnancy)
Precautions	Ensure that the placenta had delivered and that there is not another fetus before administering oxytocin Overdosage can cause uterine rupture and/ or hypertension **Pregnancy Category X**
Adverse Effects	***Neurologic:*** seizures, tetanic contractions ***Cardiovascular:*** cardiac dysrhythmias, hypertension or hypotension ***GI/GU:*** GI distress ***Reproductive:*** placental abruption, impaired uterine blood flow, uterine rupture
Onset	Immediate (IV), 3-7 minutes (IM) *(peak variable)*
Duration	1 hour (IV), 2-3 hours (IM) *(half-life 3-5 minutes)*
Dose	20-40mu/min IV or 10u IM, once
How to Mix	10u in 1000ml NS or LR, 120-240ml/hr

Phenytoin	
Class	Anticonvulsant, antidysrhythmic
Mechanism of Action	Modulates neuronal voltage-dependent sodium and calcium channels. This stabilizes neuronal membranes and limits seizure activity. Has an antiarrhythmic effect by normalizing sodium influx to cardiac fibers in patients with digitalis induced arrythmias.
Indications	Seizure: to prevent or stop seizure activity Toxic Exposure: to prevent or convert dysrhythmias due to digitalis toxicity
Absolute Contraindications	• Bradycardia or high-grade heart blocks • Hypotension
Precautions	Should not be administered with glucose solutions Hemodynamic adverse effects are accentuated by rapid infusion **Pregnancy Category D**
Adverse Effects	***Neurologic:*** central nervous system (CNS) depression, toxic delirium, nystagmus, ataxia, slurred speech, dizziness, confusion, blurred vision, somnolence, headache ***Cardiovascular:*** hypotension, ventricular dysrhythmia, cardiovascular collapse, AV conduction abnormalities, blood dyscrasias ***GI/GU:*** nausea, vomiting, constipation ***Skin:*** itching, local venous irritation, tissue necrosis, rash, Stevens-Johnson Syndrome, toxic epidermal necrolysis (TEN)
Onset	3-5 minutes *(peak 1-2 hours)*
Duration	Variable *(half-life 22 hours)*
Dose	***Seizure*** *Adult:* 15-20mg/kg over 20min (max 50mg/min), once (use filter) *Pediatric:* 20mg/kg (max 1000mg) over 20mg, once (use filter) ***Digitalis Toxicity*** *Adult:* 100mg over 5 minutes, may repeat to total dose 1000mg[99] *Pediatric:* not indicated[100]

[99] Confirmed in PDR Network (2018)

[100] Couldn't find any guidance here and we'd be unlikely to see it anyways

Promethazine	
Class	Phenothiazine antihistamine (H_1 antagonist), antiemetic
Mechanism of Action	Promethazine is a phenothiazine derivative with primarily antihistaminic effects that also has antiemetic, anticholinergic and sedative actions.[101] It competitively blocks H1 receptor sites but does not block histamine release.
Indications	Pain, Agitation & Nausea: to prevent or reduce severity of nausea and vomiting
Absolute Contraindications	Known sulfite allergy (additive)
Precautions	Use caution with concurrent: • History or possibility of seizures (can lower threshold) • Decreased level of consciousness (can be exacerbated) • Head injury (to do risk of both seizures and decreased level of consciousness) Dilute prior to administration Avoid accidental intraarterial injection, extravasation can cause tissue damage ("black box" warning) **Pregnancy Category C**
Adverse Effects	***Neurological:*** may impair mental and physical ability, drowsiness, sedation, paresthesia ***Respiratory:*** respiratory depression ***Cardiovascular:*** tachycardia and bradycardia, hypotension ***Musculoskeletal:*** tremors
Onset	5 minutes (IV); 20 minutes (IM) *(peak variable)*
Duration	4-6 hours *(half-life 10-14 hours)*
Dose	*Adult:* 12.5-25 mg IV diluted in NS over 10min, once *Pediatric:* 0.1mg/kg (max 12.5mg) IV diluted in NS over 10min, once

[101] PDR Network (2018)

Propofol	
Class	Sedative/hypnotic
Mechanism of Action[102]	Propofol is an intravenous sedative-hypnotic agent for use in the induction and maintenance of anesthesia or sedation. Intravenous injection of a therapeutic dose of propofol induces hypnosis with minimal excitation. The mechanism of action, like all general anesthetics, is poorly understood. However, propofol is thought to produce its sedative/ anesthetic effects by the positive modulation of the inhibitory function of the neurotransmitter GABA through the ligand-gated GABA-A receptors.
Indications	Pain, Agitation & Sedation: maintenance of sedation
Absolute Contraindications	Hypersensitivity to egg or soybean products
Precautions	May cause hypotension (however is usually transient) **Pregnancy Category B**[103]
Adverse Effects[104]	***Neurologic:*** headache ***Respiratory:*** apnea ***Cardiovascular:*** hypotension, bradycardia ***GI/GU*****:** nausea, vomiting ***Skin:*** pain on induction
Onset	9-36 seconds *(peak 3-5 minutes)*
Duration	6-10 minutes *(half-life 5-12 hours)*
Dose	*Infusion:* 5-200mcg/kg/min[105]
How to Mix	Not required, spike the bottle directly and use vented tubing

[102] Hospira (2016)
[103] Hospira (2016)
[104] Barringer Group, LLC (2019)
[105] Hospira (2016); Barringer, LLC (2019)

Regular Insulin	
Class	Pancreatic hormone, antidiabetic agent
Mechanism of Action	Replaces physiologic production of insulin in patients with diabetes. Increases glucose transport across muscle and fat cell membranes to reduce blood glucose levels.
Indications	Diabetic Emergencies: to reduce BGL by moving glucose into the cells Electrolyte Abnormalities & Crush Injury: to treat hyperkalemia by facilitating the movement of potassium in to the cells
Absolute Contraindications	Hypoglycemia
Precautions	Regular insulin may be adsorbed into the container or tubing when added to an IV infusion solution, amount lost is variable and depends on concentration of insulin, infusion system, contact duration, and flow rate. Monitor patient response closely. Insulin is stable at room temperature up to 1 month. Avoid exposure to direct sunlight or to temperature extremes (safe rage is wide: 5-38C). During treatment for hyperglycemia with insulin infusion, check blood glucose every 30min. Insulin should be slowed or stopped if the patient's BGL falls more than 100ml/dl an hour or if the patient starts to experience signs and symptoms of increased ICP. **Pregnancy Category B**
Adverse Effects	***Neurologic:*** hypoglycemia (and subsequent decreased level of consciousness) ***Skin:*** local reaction
Onset[106]	Within 0.5 hours *(peak 1.5-3.5 hours)*
Duration[107]	Up to 8 hours
Dose	***Hyperglycemia*** *Adult:* 10u SQ and recheck in 1 hour *Pediatric:* 0.1u/kg (max 10u) SQ and recheck in 1 hour *Infusion:* 0.1u/kg/hr ***Hyperkalemia*** *Adult:* 10u IV *Pediatric:* 0.1u/kg IV (to be given with simultaneously with Dextrose)
How to Mix	100u in 100ml of NS or D5W (yields 1u/ml)

[106] Biocon (2015)
[107] Biocon (2015)

Rocuronium	
Class	Nondepolarizing neuromuscular blocker
Mechanism of Action	Acts by binding competitively to cholinergic receptors at the motor end plate to antagonize the action of acetylcholine, an effect that is reversible in the presence of acetylcholinesterase, such as neostigmine and edrophonium
Indications	Rapid Sequence Intubation: to induce paralysis to facilitate intubation
Absolute Contraindications	None
Precautions	Use caution with concurrent: • Difficult airway or severe obesity (may be difficult to secure, consider short acting paralytic) • Seizures or possibility of seizures (prolonged paralysis can mask seizure activity) • Impaired liver function (decreased metabolization, will have longer duration of action) Will cause apnea **Pregnancy Category B**
Adverse Effects	***Respiratory:*** apnea, bronchospasm ***Cardiovascular:*** dysrhythmia, hypertension or hypotension ***Skin:*** injection site pain
Onset	3 min
Duration	30 min
Dose	*Adult & Pediatric:* 1mg/kg IV

Sodium Bicarbonate	
Class	Alkalinizing agent, electrolyte replenisher
Mechanism of Action	IV sodium bicarbonate therapy increases plasma bicarbonate, buffers excess hydrogen ion concentration, raises blood pH and reverses the clinical manifestations of acidosis. The bicarbonate that is in excess of what the body needs to buffer hydrogen ions causes systemic alkalization and, when excreted, urinary alkalization.
Indications	Electrolyte Abnormalities & Crush Injury: to facilitate the shift of potassium back in to the intracellular space with hyperkalemia, Toxic Exposure: to convert or prevent dysrhythmia and hypotension with tricyclic antidepressant overdose
Absolute Contraindications	• Alkalotic states • Lactic acidosis
Precautions	Use caution with risk of hypernatremia ((can contribute to hypernatremia[108]), such as: • CHF or other edematous or Na-retaining states • Hypochloremia (due to diuretics, vomiting or gastric lavage) • Oliguria or anuria Use caution with concurrent: • Administration of corticosteroids or corticotropin[109] • Hypokalemia (can predispose the patient to metabolic alkalosis) • Hypocalcemia (as the pH rises, can cause carpopedal spasm) Extravasation can cause chemical cellulitis with tissue necrosis, ulceration or sloughing at the site Correct dosage is essential to avoid overcompensation of pH **Pregnancy Category C**
Adverse Effects	***Neurologic:*** muscular twitching, irritability, tetany ***Endocrine/ Metabolic:*** metabolic alkalosis
Onset	Immediate *(peak < 15 minutes)*
Duration	1-2 hours
Dose	*Adult:* 50mEq IV, repeat as needed *Pediatric:* 1mEq/kg (max 50mEq) IV, repeat as needed

[108] PDR Network (2018)
[109] Find a good reason here

Streptokinase	
Class	Fibrinolytic
Mechanism of Action[110]	Acts with plasminogen (or plasmin) to produce an "activator complex" that converts residual plasminogen into the proteolytic enzyme, plasmin. Plasmin is capable of hydrolyzing fibrin into polypeptides; it also hydrolyzes fibrinogen and other plasma proteins. Since plasminogen is present in the thrombus/ embolus, activation by streptokinase occurs within the thrombus/ embolus as well as on its surface.
Indications	Acute Coronary Syndrome: to lyse clot and reverse ischemia associated with myocardial infarction Pulmonary Embolism: to lyse clot and improve cardiopulmonary function Stroke: to lyse clot and reverse ischemia associated with thrombotic occlusion
Absolute Contraindications	As outlined in Thrombolytic Checklist (applies to all indications/ uses) • Stroke or head trauma within the past three months • Previous intracranial hemorrhage • Previous intracranial or intraspinal surgery • SBP ≥185 or DBP≥110 that does not respond to treatment[111] • BGL <50 that does not respond to treatment • Bleeding, clotting problem or blood thinners • Right arm vs left arm SBP >15 • Pregnant female • Serious systemic disease (i.e. advanced cancer, severe liver or kidney disease, acute pancreatitis[112])
Precautions	Note: attempt should be made to contact [redacted] Medical Director prior to administration Use caution with concurrent (due to increased risk of bleeding): • Suspected aortic dissection • Traumatic cardiopulmonary resuscitation • Known intracranial tumor • History of stroke in the past six months May be ineffective if administered within 12 months of prior streptokinase or therapy Antidysrhythmic and resuscitative medications should be available Increased risk for side effects with *any* known drug allergy[113] Increased risk for side effects, but greater efficacy[114], with faster administration

[110] CSL Behring (2007)
[111] CSL Behring (2007)
[112] CSL Behring (2007)
[113] Aslanabadi, et al. (2018); Malik & Khan (2004)
[114] Bendary, et al. (2017)

	Pregnancy Category C[115]
Adverse Effects	***Neurologic:*** fever ***Cardiovascular:*** bleeding, hypotension[116] ***GI/GU:*** nausea, vomiting
Onset	< 1 hour *(peak 80 minutes)*
Duration	2-36 hours *(83 minutes)*
Dose	***Acute MI*** 1,500,000u IV over 30 - 60min, once[117] ***Pulmonary Embolism*** Loading Dose: 250,000u IV over 30min[118] Subsequent Infusion: 100,000u/hr for 24 hours ***Stroke*** *Adult >65kg:* 1,500,000u IV over 60min, once *Adult <65kg:* 1,200,000u IV over 60min, once[119]
How to Mix	***Acute MI***[120] • 1,500,000u (one vial) in 50ml NS or D5W • Reconstitute vial with 5ml fluid from the bag • Add reconstituted med back to bag • Administer at 50 – 100ml/hr ***Pulmonary Embolism***[121] • 300,000u (two vials) in 90ml NS or D5W • Start with 100ml NS or D5W • Waste 10ml from that bag • Take another 10ml from that bag, use it to reconstitute 2 vials of streptokinase • Mix those vials in the 80ml remaining in the bag • Yields 3,000,000u in 90ml (33,333.3u/ml) • Loading Dose: 7.5ml over 30min (set pump to 15ml/hr for 30min) • Subsequent Infusion: 3ml/hr ***Stroke***[122] • 1,500,000u (one vial) in 50ml NS or D5W • Reconstitute vial with 5ml fluid from the bag • Add reconstituted med back to bag • Adults >65kg: administer at 50ml/hr for one hour • Adults <65kg: administer at 40ml/hr for one hour (10ml will not be given)

115

116 Aslanabadi, et al. (2018); Lateef & Anatharam (2000); CSL Behring (2007)

117 Abbot (date unknown); CSL Behring (2007)

118 Abbot (date unknown); CSL Behring (2007)

119 Wasn't able to find the reference for this dose

120 Abbot (date unknown)

121 CSL Behring (2007)

122 John Wiley & Sons, Ltd. (2016)

Succinylcholine	
Class	Depolarizing neuromuscular blocking agent
Mechanism of Action	Short acting skeletal muscle relaxant that exerts effects by binding with cholinergic receptor sites, producing depolarization and preventing the action of acetylcholine. This depolarization is observed as fasciculations of muscle groups.
Indications	Rapid Sequence Intubation: to achieve paralysis to facilitate endotracheal intubation
Absolute Contraindications	• Hyperkalemia • Crush/ severe trauma >2 days • Spinal cord injury >2 days • Burn >24hrs, • Renal failure • Pseudocholinesterase deficiency, • Known history of malignant hyperthermia, • Neuromuscular disorders (i.e. muscular dystrophy), • Penetrating eye injury
Precautions	Use caution with concurrent: • Family history of malignant hyperthermia • Family history of skeletal muscle myopathies • Suspected hyperkalemia • Denervation of skeletal muscle or upper motor neuron injury Malignant hyperthermia presents with spasm of the masseter (jaw) muscles progressing to generalized rigidity, tachycardia, tachypnea and elevated temperature. Treatment is Dantrolene and not readily available in [redacted][123] Cardiac dysrhythmia may occur with concurrent electrolyte abnormalities and/ or digitalis toxicity. May be stored out of refrigeration at room temperature for 14 days. **Pregnancy Category Unknown**
Adverse Effects	***Neurologic:*** malignant hyperthermia ***Cardiovascular:*** hypotension, bradycardia ***Musculoskeletal:*** prolonged paralysis
Onset	30-60 seconds (IV), 2-3 minutes (IM) *(peak 1-3 minutes)*
Duration	2-3 minutes (IV), 10-30 minutes (IM) *(half-life 5-10 minutes)*
Dose	*Adult:* 1.5-2mg/kg IV *Pediatric:* 2mg/kg IV

[123] Can we verify this? Do you know?

Terbutaline	
Class	Sympathomimetic, beta-2 agonist (bronchodilator and tocolytic)
Mechanism of Action	B-adrenergic receptor agonist which exerts a preferential effect on B-2 adrenergic receptors, such as those located in smooth muscle. The B-adrenergic agonists produce many of the pharmacologic effects by activation of adenyl cyclase, the enzyme which catalyzed the conversion of adenosine triphosphate to cyclic adenosine monophosphate. It is excreted in the urine.
Indications	Bronchospasm: to cause bronchodilation with reversable etiology (i.e. asthma, COPD, allergic reaction) Preterm Labor & Tocolytics: to induce tocolysis/ postpone delivery of a fetus
Absolute Contraindications	History of sensitivity to sympathomimetic amines[124]
Precautions	Use caution with concurrent[125]: • Cardiovascular disorders or digitalis use (can increase sympathetic response and lengthen QT segment) • Hyperthyroidism (may be more sensitive to adverse effects) • Diabetes mellitus (can aggravate DKA) • History of seizures (may case seizures) May cause pulmonary edema in pregnancy Monitor for hypokalemia **Pregnancy Category B**
Adverse Effects	***Neurologic:*** anxiety, nervousness, headache, dizziness, drowsiness ***Cardiovascular:*** palpitations, tachycardia, premature ventricular contractions ***GI/GU:*** nausea, vomiting ***Musculoskeletal:*** tremors, muscle cramps
Onset	< 15 minutes (SC) *(peak 30-60 minutes (SC)*
Duration	1.5-4 hours (SC) *(half-life 3-4 hours)*
Dose[126]	***Bronchospasm*** *Adult:* 0.25mg SQ, may repeat once *Pediatric:* 0.005 – 0.01mg/kg SQ, may repeat once ***Tocolysis*** 0.25mg SQ, may repeat to 3 total doses or until Magnesium Sulfate is ready

[124] Such as Ephedrine

[125] List comes from Blesdoe & Clayden (2019) and [redacted] explanations all come from PDR Network (2018)

[126] Here says SQ, FRGs say IM – normally it is SQ, but would there be a faster onset with IM? Need to look in to that (or just list it as IM/SQ in both spots)

Tetanus Immune Globulin/ Tetanus Anti-Toxin[127]	
Class	Immunoglobin
Mechanism of Action	Tetanus Anti-Toxin is a sterile proteolytically refined solution of globulins. It is prepared from serum obtained from equines (horses), hyperimmunized with tetanus toxoid and toxin.[128] Tetanus Immune Globulin is a human-prepared immunoglobulin that provides passive immunity towards tetanus by supplying antibodies to neutralize the free form of toxins produced by *Clostridium tetani.*[129] While both the Immune Globulin and Anti-Toxin contain immunoglobulins that help remove unbound tetanus toxin after exposure, their preparation is different and they are referred to in this document as follow: • "Equine Preparation" – Anti-Toxin • "Human Preparation" – Tetanus Immune Globulin (TIG) Note that "Tetanus Toxoid" refers to a vaccination and is both different in nature from the Immune Globulin/ Anti-Toxin and not typically available as a single shot, rather it is included in the "Tdap."[130]
Indications	Tetanus: prophylaxis for tetanus, treatment of tetanus
Absolute Contraindications	Previous anaphylactic reaction to equine sera (when using the equine preparation)
Precautions	Use caution with concurrent history of allergic diseases (such as asthma, eczema, hay fever, etc.) There is an increased risk of allergic reaction with equine preparation, therefore precautions should be taken (i.e. intradermal skin test prior to full dose) Should not be administered with concurrent Beta-Blocker use (other than Esmolol)[131] **Pregnancy Category C**
Adverse Effects	***Musculoskeletal:*** joint pain, edema ***Skin:*** rash, urticaria, itching
Onset	Not applicable
Duration	Not applicable

[127] SII (date unknown)
[128] SII (date unknown)
[129] Drugs.com (2019)
[130] National (2018)
[131] WHO (2010)

Dose[132]	***Prophylaxis*** *Equine Preparation*[133] *Adult:* 3000u IM, once *Pediatric:* 1500u IM once *Human Preparation*[134] *Adult:* 250u IM, once *Pediatric:*250u IM, once ***Treatment*** *Equine Preparation*[135] *Adult:* 50,000u IV/IM, once[136] *Pediatric >50lbs (22.7kg):* 40,000u IV/IM, once *Pediatric< 50lbs (22.7kg):* 20,000u IV/IM, once[137] *Human Preparation*[138] *Adult & Pediatric:* 500u IM[139], once (and consider infiltration of additional medication around the wound)

[132] These doses are different than what I initially put in the FRGs, but reflect the Drug.com articles you had initially referenced in your protocol (it's been confusing to sift thru all the information on this!)
[133] Drugs.com (1998); "adult" defined as weighing 65lbs (29.5kg) or more
[134] Drugs.com (2019)
[135] To treat this we would need 30ish vials of the equine preparation – should we just stick with prophylaxis or can we make a note that if we have it, we can mix it up and share with the receiving?
[136] Drugs.com (1998)
[137] I wasn't able to find these pedi doses in the docs you referenced, Drugs (1998) says to match the adult dose – I'm ok to leave them as is, was just curious if you go them someplace else so that I can cite them
[138] Drugs.com (2019)
[139] Drugs.com (2019) says 3,000-6,000u, but mentions that some experts (to include the WHO and CDC) say 500u works – went with the smaller dose; if we go with that dose: National (2018); WHO (2010)

Tranexamic Acid[140]	
Class	Antifibrinolytic[141]
Mechanism of Action	Tranexamic acid is a synthetic lysine amino acid derivative that inhibits the activation of plasminogen to plasmin to prevent the breakdown of fibrin clots. With the reduction of plasmin activity, it also reduces complement and C1 activation which ultimately decreases inflammation associated with hereditary angioedema.
Indications	Shock & Trauma: to increase clot formation with life-threatening hemorrhagic related to traumatic injury Vaginal Bleed & Ectopic Pregnancy: to increase clot formation with life-threatening hemorrhage related to obstetrical issues[142]
Absolute Contraindications	• Isolated head injury • Injury greater than 3 hours old (or unknown time of onset) • Active thromboembolic disease (PE, DVT, etc.)[143]
Precautions[144]	Use caution with concurrent: • Renal insufficiency (risk of drug accumulation, consider smaller dose) • Risk of thromboembolic disease (may cause PE, DVT, etc.) • Hematuria (can cause ureter obstruction) Give slowly, as rapid administration may cause dizziness and/ or hypotension May cause thromboembolic events **Pregnancy Category B**
Adverse Effects	***Neurological:*** blurred vision, anxiety ***Respiratory:*** pulmonary edema ***Cardiovascular***: increased clot formation, DVT ***GI/GU:*** nausea, vomiting
Onset	Immediate
Duration	24hrs *(half-life 3 hours)*
Dose	*Adult:* 1g over 10min, followed by 1g over 8 hours *Pediatric:* not indicated
How to Mix	Bolus: slow IV push or dilute in 50ml NS (2 ampules) Infusion: 1g (2 ampules) diluted in NS or LR (consider placing in 1000ml bag and giving at 125ml/hr)[145]

[140] Barringer Group, LLC (2019)
[141] Samarth (date unknown)
[142] Samarth (date unknown); Sullivan (2017)
[143] Samarth (date unknown)
[144] Samarth (date unknown)
[145] Samarth (date unknown)

Vasopressin	
Class	Posterior pituitary hormone, vasoconstrictor
Mechanism of Action	Directly stimulates smooth muscle V1 receptors resulting in vasoconstriction. Acts similarly to endogenous antidiuretic hormone, causes GI peristalsis, and stimulates vasoconstriction of capillaries and small arterioles.
Indications	Shock & Hypotension: to increase BP in cases of distributive shock
Absolute Contraindications	None
Precautions	Use caution with concurrent: • Chronic nephritis accompanied by nitrogen retention[146] • Ischemic heart disease & advanced arteriosclerosis (can worsen cardiac output and precipitate anginal pain) • PVCs[147] • Pregnancy (can decrease placental blood flow[148]) **Pregnancy Category C[149]**
Adverse Effects	***Neurologic:*** headache, vertigo, fever ***Respiratory:*** bronchospasm ***Cardiovascular:*** acute coronary syndrome, bradycardia, arrythmia, hypertension, venous thrombosis, anaphylaxis ***GI/GU:*** GI distress ***Skin:*** angioedema, pallor, diaphoresis, blanching of skin, rash, urticaria
Onset	Variable
Duration	30-60 minutes *(half-life 10 - 20 minutes)*
Dose	*Adult:* 0.01-0.04 units/min *Pediatric:* not indicated for pediatric patients
How to Mix	20u in 100ml NS or D5W (yields 0.2u/ml)

[146] Find a reason (also listed in PDA Network, but no reason given)
[147] Find a reason
[148] PDA Network (2018)
[149] PDA Network (2018)

Vecuronium	
Class	Nondepolarizing neuromuscular blocking agent
Mechanism of Action	Bind to cholinergic receptors at the motor end plate. Does not produce muscular depolarization, so risk of hyperkalemic complications minimized in comparison to depolarizing agent.
Indications	Pain, Agitation & Sedation: to control agitation in a ventilated patient when other interventions are ineffective
Contraindications	• Unsecured airway • Inadequate confirmation of endotracheal tube
Precautions	With agitation that can be managed by other means, defer from paralysis Use caution with concurrent: • Sever hepatic disease (can cause prolonged neuromuscular blockade[150]) • Neuromuscular disorder (myasthenia gravis – can cause prolonged neuromuscular blockade[151]) Concomitant sedative and analgesic use required **Pregnancy Category C**
Adverse Effects	***Respiratory:*** apnea ***Cardiovascular:*** hypotension, tachycardia and bradycardia, circulatory collapse
Onset[152]	2.5-3min
Duration[153]	1.5 hours *(half-life 45-65 minutes)*
Dose	*Adult & Pediatric:* 0.1mg/kg IV, repeat as needed

[150] PDA Network (2018)
[151] PDA Network (2018)
[152] Barringer Group, LLC (2019)
[153] Barringer Group, LLC (2019)

Drug	
Class	
Mechanism of Action	
Indications	
Contraindications	
Precautions	
Adverse Effects	
Onset	
Duration	
Field Reference Guides	
Dose	

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